

input and feedback signals before taking the difference to create the error signal, it is more efficient to form the error signal with a continuous-time (non-sampling) circuit followed by a gain stage and then sample this amplified error signal using a switched-capacitor circuit. This arrangement causes the input-referenced switch thermal noise to be reduced by the amount of the gain used in the error path. The amount of gain that can be used in the error path depends on how closely the output tracks the input; it is desirable to make this gain as large as possible without causing the error signal to exceed the supply voltage.

Claims 4, 6 and 9 stand rejected under 35 U.S.C. §102(e) as allegedly being anticipated by U.S. Patent No. 5,973,518 to Vallancourt (hereinafter "Vallancourt"). For this rejection, the Examiner relies on ¶3 of the Office Action dated November 4, 2002 and the Advisory Action dated April 2, 2003, in which the Examiner states:

Applicant argues that the Vallancourt patent fails to disclose a quantizer for quantizing the feedback signal to the input/summing circuit. However, as pointed out in the last Office Action, sample and hold circuits such as that of the Vallancourt are generally used in conjunction with A/D converter, see col. 2, lines 19-25, which requires quantizing the sampled signal. The present application also admits to such quantization of the feedback signal as prior art at page 2. Thus, in the case that the sample and hold circuit of the Vallancourt patent is used for A/D converting, the quantization of the feedback signal is required.

The Examiner's argument fails to acknowledge that one of the elements as claimed by Applicants is "a feedback circuit, responsive to said quantizer circuit, for delivering to said input circuit said quantized feedback signal". Rather, the Examiner again relies on Vallancourt's discussion of using an A/D converter *after* the disclosed circuit as a rejection for Applicants' invention in which a quantized feedback signal is delivered to the input circuit. Vallancourt does not disclose or suggest whatsoever that a quantizer could be included in the

disclosed feedback loop to the input circuit.

The proper test of novelty under 35 U.S.C. §102 makes inquiry whether each element of the claim is embodied in a single prior art reference. National Athletic Supply Corp. v. Muscle-Matic, Inc. et al., 164 U.S.P.Q. 10 (D.C.M.Fla., 1968). The same or identical device or invention must be disclosed in a single prior art structure. Arnel Industries, Inc. v. Aerosol Research Co., 164 U.S.P.Q. 239 (D.C.N.Ill., 1969). There is no anticipation under 35 U.S.C. §102 unless there is a single reference that shows or suggests the structure and relationship of the parts defined in the claims. Hamilton Mfg. Co. v. Westinghouse Electric Corp., 164 U.S.P.Q. 284 (D.C.N.Ill., 1969).

Stated differently, the proper test for anticipation is whether the prior art reference describes the invention with such sufficient clarity and specificity that one skilled in the art could practice the invention without assistance from the application claimed to have been anticipated. Columbia Broadcasting System v. Sylvania Electric Products, Inc., 162 U.S.P.Q. 577 (1st Cir., 1970). Certainly that is not the case here since Vallancourt does not disclose or suggest whatsoever that a quantizer could or should be included in the disclosed feedback loop to the input circuit.

Vallancourt shows a sample and hold circuit that can be powered with a low voltage supply, e.g., of about 1 volt. Referring to Fig. 3, to which the Examiner cites in the Office Action dated November 4, 2002, Vallancourt shows a sample and hold circuit that includes an operational amplifier OA4 which accepts as an input an analog feedback signal. The output of the sample and hold circuit can be sent to other circuitry, such as an analog-to-digital converter.

Vallancourt does not disclose or suggest, however, “a quantizer circuit for quantizing the output of [a] filter circuit; [and] a feedback circuit, responsive to said quantizer circuit, for

delivering to said input circuit said quantized feedback signal” as claimed by the Applicants.

The Examiner cites the following passage of Vallancourt as allegedly disclosing a quantizer as part of a filter system:

A sample and hold (S/H) circuit repeatedly captures and maintains a single sample of either the current or voltage of a time-varying signal long enough *for an analog-to-digital converter (ADC) or other subsequent circuit* to utilize that stabilized sample. Without a sample and hold circuit, the accuracy of *the ADC or other circuitry following the sample and hold circuit* would deteriorate due to their vulnerability to fluctuations in the input signal during the length of time that the sample is being utilized by *subsequent circuitry*.

Vallancourt at column 2, lines 19-27 (emphasis added). Thus, those skilled in the art will understand that Vallancourt describes using an analog to digital converter *after* the disclosed circuits, not as a part of a feedback loop or part of any of the disclosed circuits. Moreover, Vallancourt does not disclose using a quantizer in a $\Sigma\Delta$ modulator circuit.

Additionally, Vallancourt clearly fails to disclose a circuit for reducing input-referred thermal noise by a factor of approximately the gain of the amplification.

Claim 4 of the subject invention recites: “A $\Sigma\Delta$ modulator with a filter system having reduced switch thermal noise comprising: an input circuit for receiving an input signal and a quantized feedback signal and providing a signal representative of the difference; a filter circuit including at least an input sampling capacitor and switch which introduces thermal noise error; a quantizer circuit for quantizing the output of said filter circuit; a feedback circuit, responsive to said quantizer circuit, for delivering to said input circuit said quantized feedback signal; and said input circuit including means for amplifying said difference signal, before it is submitted to said filter circuit to reduce the input-referred thermal noise by a factor of approximately the gain of the amplification.” (Emphasis added.) Vallancourt does not disclose or suggest such a structure

because Vallancourt does not disclose a $\Sigma\Delta$ modulator circuit having a quantizer that quantizes the output of a filter circuit.

Also, Vallancourt does not disclose the subject matter of independent claim 9, which recites: "A $\Sigma\Delta$ modulator with a filter system having reduced switch thermal noise comprising: a summing circuit for receiving an input signal and a quantized feedback signal and providing a signal representative of the difference; a filter circuit including at least an input sampling capacitor and switch which introduces thermal noise error; a quantizer circuit for quantizing the output of said filter circuit; a feedback circuit, responsive to said quantizer circuit, for delivering to said summing circuit said quantized feedback signal; and an amplifier circuit for amplifying said difference signal, before it is submitted to said filter circuit to reduce the input-referred thermal noise by a factor of approximately the gain of said amplifier circuit."

Vallancourt also does not disclose or suggest such a structure because Vallancourt does not disclose a $\Sigma\Delta$ modulator circuit having a quantizer.

Accordingly, Vallancourt does not disclose or suggest the structure of the claims of the subject application as amended. Applicants respectfully request that the Examiner remove the rejections under 35 U.S.C. §102(e).

Claims 4 and 10 stand rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Vallancourt. Independent claim 4 is patentable for the reasons stated above. Claim 10 depends from independent claim 9 and thus incorporates the features of claim 9 and also includes one or more additional features that distinguish over Vallancourt. As such, claim 10 is patentable for at least the reasons stated above.

Vallancourt does not make obvious the subject invention because one skilled in the art would have no motivation to include a quantizer within the feedback loop of any of the

Vallancourt circuits. Vallancourt provides no teaching or suggestion to include a quantizer within a feedback loop. In fact, Vallancourt actually teaches away from using a quantizer within a feedback loop because the feedback loops of Vallancourt carry analog signals and are coupled directly to an analog operational amplifier. Thus, Vallancourt does not disclose or suggest “a quantizer circuit for quantizing the output of said filter circuit; [and] a feedback circuit, responsive to said quantizer circuit, for delivering to said input circuit said quantized feedback signal” as claimed by the Applicants.

Accordingly, Vallancourt does not make obvious the claims of the subject invention. Applicants respectfully request that the Examiner withdraw the rejections under U.S.C. §103(a).

As noted above, in the Advisory Action dated April 2, 2003, the Examiner stated that “[t]he present application also admits to such quantization of the feedback signal as prior art at page 2.” In effect, the Examiner implies that the prior art mentioned in the subject application at page 2 could be combined with Vallancourt. However, the Examiner offers no explanation of why it would be obvious to combine the teachings of Vallancourt and other prior art in the first place.

When patentability turns on the question of obviousness, the search for and analysis of the prior art includes evidence relevant to the finding of whether there is a teaching, motivation, or suggestion to select and combine the references relied on as evidence of obviousness. See, e.g., McGinley v. Franklin Sports, Inc., 262 F.3d 1339, 1351-52, 60 USPQ2d 1001, 1008 (Fed. Cir. 2001) (“the central question is whether there is reason to combine [the] references,” a question of fact drawing on the Graham factors).

“The factual inquiry whether to combine references must be thorough and searching.” Id. It must be based on objective evidence of record. This precedent has been reinforced in myriad decisions, and cannot be dispensed with. See, e.g., Brown & Williamson Tobacco Corp. v. Philip

Morris Inc., 229 F.3d 1120, 1124-25, 56 USPQ2d 1456, 1459 (Fed. Cir. 2000) (“a showing of a suggestion, teaching, or motivation to combine the prior art references is an ‘essential component of an obviousness holding’”) (quoting C.R. Bard, Inc., v. M3 Systems, Inc., 157 F.3d 1340, 1352, 48 USPQ2d 1225, 1232 (Fed. Cir. 1998)); In re Dembiczak, 175 F.3d 994, 999, 50 USPQ2d 1614, 1617 (Fed. Cir. 1999) (“Our case law makes clear that the best defense against the subtle but powerful attraction of a hindsight-based obviousness analysis is rigorous application of the requirement for a showing of the teaching or motivation to combine prior art references.”); In re Dance, 160 F.3d 1339, 1343, 48 USPQ2d 1635, 1637 (Fed. Cir. 1998) (there must be some motivation, suggestion, or teaching of the desirability of making the specific combination that was made by the applicant); In re Fine, 837 F.2d 1071, 1075, 5 USPQ2d 1596, 1600 (Fed. Cir. 1988) (“teachings of references can be combined only if there is some suggestion or incentive to do so.”) (emphasis in original) (quoting ACS Hosp. Sys., Inc. v. Montefiore Hosp., 732 F.2d 1572, 1577, 221 USPQ 929, 933 (Fed. Cir. 1984)).

The need for specificity pervades this authority. See, e.g., In re Kotzab, 217 F.3d 1365, 1371, 55 USPQ2d 1313, 1317 (Fed. Cir. 2000) (“particular findings must be made as to the reason the skilled artisan, with no knowledge of the claimed invention, would have selected these components for combination in the manner claimed”); In re Rouffet, 149 F.3d 1350, 1359, 47 USPQ2d 1453, 1459 (Fed. Cir. 1998) (“even when the level of skill in the art is high, the Board must identify specifically the principle, known to one of ordinary skill, that suggests the claimed combination. In other words, the Board must explain the reasons one of ordinary skill in the art would have been motivated to select the references and to combine them to render the claimed invention obvious.”); In re Fritch, 972 F.2d 1260, 1265, 23 USPQ2d 1780, 1783 (Fed. Cir. 1992) (the examiner can satisfy the burden of showing obviousness of the combination “only by showing some objective teaching in the prior art or that knowledge generally available to one of ordinary skill in the art would lead that individual to combine the relevant teachings of the references”).

In re Sang Su Lee, 277 F. 3d 1338, 61 USPQ2d 1430 (Fed. Cir. 2002).

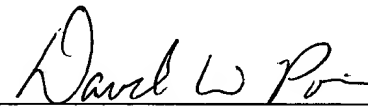
Hence, there is no suggestion that Vallancourt’s sample and hold circuit could use in the feedback loop disclosed in Vallancourt the prior art quantizer mentioned in the subject application. Only the Applicants’ own disclosure teaches how a $\Sigma\Delta$ modulator with a filter

system having reduced switch thermal noise can include, *inter alia*, a quantizer circuit for quantizing the output of a filter circuit, and a feedback circuit, responsive to the quantizer circuit, for delivering to an input circuit the quantized feedback signal, and it is improper to use the Applicants' disclosure as a blue print for conducting a hindsight §103 analysis.

Each of the Examiner's rejections has been addressed or traversed. Accordingly, it is respectfully submitted that the application is in condition for allowance. Early and favorable action is respectfully requested.

If for any reason this Response is found to be incomplete, or if at any time it appears that a telephone conference with counsel would help advance prosecution, please telephone the undersigned or his associates, collect in Waltham, Massachusetts, at (781) 890-5678.

Respectfully submitted,


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